CLAIMS

I/We claim:

[c1] 1. A system for testing a microfeature device having a substrate and a plurality of interconnect elements projecting from the substrate, the system comprising:

a test socket including a support surface and a plurality of apertures in the support surface arranged to receive corresponding interconnect elements of the microfeature device, the individual apertures extending through the test socket and having a cross-sectional dimension less than a cross-sectional dimension of the interconnect elements so that the substrate is spaced apart from the support surface when the microfeature device is received in the test socket; and

a tester interface including a plurality of test contacts, the test socket being movable relative to the tester interface between a first position in which at least some of the test contacts are inserted into corresponding apertures and a second position in which the test contacts are removed from the corresponding apertures.

[c2] 2. The system of claim 1 wherein the apertures in the support surface are arranged in rows and columns corresponding to an array of interconnect elements on the microfeature device.

[c3] 3. The system of claim 1 wherein:

the support surface comprises an opening; and

the apertures in the support surface are arranged around the perimeter of the opening so that when the microfeature device is received in the test socket, the apertures receive the corresponding interconnect

elements and the other interconnect elements are positioned at the opening.

[c4] 4. The system of claim 1 wherein:

the support surface comprises an opening; and

the apertures comprise at least three apertures around the opening.

[c5] 5. The system of claim 1 wherein the cross-sectional dimension of the individual apertures is from approximately 70 percent to approximately 80 percent of the cross-sectional dimension of the corresponding interconnect elements.

[c6] 6. The system of claim 1 wherein the test socket further comprises:

a body having a recess to receive the microfeature device and a shelf in the recess; and

a ball support member carried by the shelf and having the support surface.

[c7] 7. The system of claim 1 wherein the individual apertures comprise a beveled portion.

[c8] 8. The system of claim 1 wherein:

the test socket further comprises an exterior surface opposite the support surface; and

the individual apertures comprise a first beveled portion proximate to the support surface and a second beveled portion proximate to the exterior surface.

[c9] 9. The system of claim 1 wherein:

the diameter of the individual apertures is a first, smallest diameter in the apertures; and

the individual apertures comprise a first portion having the first, smallest diameter and a second portion having a second diameter greater than the first diameter.

[c10] 10. The system of claim 1 wherein:

the support surface comprises an opening; and

the apertures comprise four or less apertures around the opening.

[c11] 11. A system for testing a plurality of microfeature devices, the individual microfeature devices including a substrate and an array of conductive balls on the substrate, the system comprising:

a test tray including a plurality of test sockets to receive corresponding microfeature devices, the individual test sockets including a support surface and an array of apertures in the support surface corresponding to at least some of the conductive balls of the respective microfeature device, wherein the individual apertures extend through the test socket and are sized to receive a portion of a corresponding conductive ball so that the substrate is spaced apart from the support surface when the respective microfeature device is received in the individual test socket; and

a tester interface including a plurality of test contact arrays, wherein the individual test contact arrays are aligned to selectively contact a corresponding conductive ball array.

[c12] 12. The system of claim 11 wherein the apertures in the support surface of the individual test sockets are arranged in rows and columns corresponding to the array of conductive balls on the respective microfeature device.

[c13] 13. The system of claim 11 wherein:

the support surface of the individual test sockets comprises an opening; and

the apertures in the support surface of the individual test sockets are arranged around the perimeter of the opening so that when the respective microfeature device is received in the test socket, the apertures receive corresponding conductive balls and the other conductive balls are positioned at the opening.

[c14] 14. The system of claim 11 wherein the individual apertures have a diameter less than a diameter of the corresponding conductive ball.

[c15] 15. The system of claim 11 wherein the individual test sockets further comprise:

a body having a recess to receive the microfeature device and a shelf in the recess; and

a ball support member carried by the shelf and having the support surface.

[c16] 16. The system of claim 11 wherein the individual apertures comprise a first portion having a first diameter and a second portion having a second diameter greater than the first diameter.

[c17] 17. A test socket for receiving a microfeature device having a substrate and a plurality of interconnect elements projecting from the substrate, the test socket comprising a recess having a lead-in surface and a support surface, the support surface including a plurality of apertures positioned to receive corresponding interconnect elements of the microfeature device, wherein the individual apertures extend through the test socket and have a cross-sectional dimension less than a cross-sectional dimension of the interconnect elements so

that the substrate is spaced apart from the support surface when the microfeature device is received in the recess.

[c18] 18. The test socket of claim 17 wherein the apertures in the support surface are arranged in rows and columns corresponding to an array of interconnect elements on the microfeature device.

[c19] 19. The test socket of claim 17 wherein:

the support surface further comprises an opening; and

the apertures in the support surface are arranged around the perimeter of the opening so that when the microfeature device is received in the recess, the apertures receive the corresponding interconnect elements and the other interconnect elements are positioned at the opening.

[c20] 20. The test socket of claim 17 wherein:

the support surface further comprises an opening; and

the apertures comprise at least three apertures around the opening.

[c21] 21. The test socket of claim 17 wherein the cross-sectional dimension of the individual apertures is from approximately 70 percent to approximately 80 percent of the cross-sectional dimension of the corresponding interconnect elements.

[c22] 22. The test socket of claim 17, further comprising:

a body having the recess and a shelf; and

a ball support member carried by the shelf and having the support surface.

[c23] 23. The test socket of claim 17 wherein the individual apertures comprise a beveled portion.

[c24] 24. The test socket of claim 17, further comprising an exterior surface opposite the support surface, and wherein the individual apertures comprise a first beveled portion proximate to the support surface and a second beveled portion proximate to the exterior surface.

[c25] 25. The test socket of claim 17 wherein:

the cross-sectional dimension of the individual apertures is a first, smallest diameter in the apertures; and

the individual apertures comprise a first portion having the first, smallest diameter and a second portion having a second diameter greater than the first diameter.

[c26] 26. A test socket for receiving a microfeature device having a substrate and a plurality of interconnect elements projecting from the substrate, the test socket comprising a support surface and a plurality of apertures in the support surface configured to receive a corresponding plurality of interconnect elements of the microfeature device, wherein individual apertures extend through the test socket and are configured to receive only a distal portion of a corresponding interconnect element so that the substrate is spaced apart from the support surface when the microfeature device is received in the test socket.

[c27] 27. The test socket of claim 26 wherein the individual apertures have a cross-sectional dimension less than a cross-sectional dimension of the corresponding interconnect element.

[c28] 28. The test socket of claim 26 wherein the individual apertures comprise a first portion having a first cross-sectional dimension and a second portion having a second cross-sectional dimension greater than the first cross-sectional dimension.

[c29] 29. The test socket of claim 26 wherein the apertures in the support surface are arranged in rows and columns corresponding to an array of interconnect elements on the microfeature device.

[c30] 30. The test socket of claim 26 wherein:

the support surface further comprises an opening; and

the apertures in the support surface are arranged around the perimeter of the opening so that when the microfeature device is received in the test socket, the apertures receive the corresponding interconnect elements and the other interconnect elements are positioned at the opening.

[c31] 31. The test socket of claim 26, further comprising:

a body having a recess to receive the microfeature device and a shelf in the recess; and

a support member carried by the shelf and having the support surface.

[c32] 32. A test socket for receiving a microfeature device having a substrate and a plurality of solder balls on the substrate, the test socket comprising:

a body including a recess, a lead-in surface partially defining the recess, and a shelf in the recess; and

a ball support member carried by the shelf, the ball support member including a plurality of apertures positioned to receive corresponding solder balls of the microfeature device, wherein individual apertures extend through the ball support member and are sized to receive a portion of a corresponding solder ball so that the substrate is spaced apart from the support surface when the microfeature device is received in the test socket.

[c33] 33. The test socket of claim 32 wherein the individual apertures have a diameter less than a diameter of the corresponding solder ball.

[c34] 34. The test socket of claim 32 wherein the individual apertures comprise a first portion having a first diameter and a second portion having a second diameter greater than the first diameter.

[c35] 35. The test socket of claim 32 wherein the apertures in the ball support member are arranged in rows and columns corresponding to an array of solder balls on the microfeature device.

[c36] 36. The test socket of claim 32 wherein:

the ball support member further comprises an opening; and

the apertures in the ball support member are arranged around the perimeter of the opening so that when the microfeature device is received in the test socket, the apertures receive the corresponding solder balls and the other solder balls are positioned at the opening.

[c37] 37. A test socket for receiving a microfeature device having a substrate and an array of conductive balls on the substrate, the test socket comprising a support surface and a plurality of apertures arranged in an array corresponding to the array of conductive balls of the microfeature device, wherein the individual apertures extend through the test socket and have a first diameter at the support surface and a second diameter spaced apart from the support surface, wherein the second diameter is less than the first diameter such that the substrate is spaced apart from the support surface when the microfeature device is received in the test socket.

[c38] 38. A test socket for receiving a microfeature device having a substrate and a plurality of interconnect elements projecting from the substrate, the test

socket comprising a lead-in surface and a means for supporting the microfeature device within the test socket with the interconnect elements accessible for testing and without the substrate contacting the test socket.

[c39] 39. A method of testing a microfeature device having a substrate and a plurality of interconnect elements projecting from the substrate, the method comprising:

providing a test socket including a support surface and a plurality of apertures in the support surface;

placing the microfeature device in the test socket such that several interconnect elements are received partially within corresponding apertures to provide a gap between the substrate and the support surface; and

inserting test contacts into the corresponding apertures to contact the interconnect elements received in the apertures.

[c40] 40. The method of claim 39 wherein placing the microfeature device in the test socket comprises aligning the interconnect elements on the microfeature device with corresponding test contacts.

[c41] 41. The method of claim 39 wherein placing the microfeature device in the test socket comprises spacing the substrate apart from the support surface so that debris on the support surface does not contact the substrate.

[c42] 42. The method of claim 39 wherein:

the substrate further includes a first surface, a second surface opposite the first surface, and a plurality of ends connecting the first and second surfaces; and

placing the microfeature device in the test socket comprises aligning the interconnect elements on the microfeature device with

corresponding test contacts without reference to the ends of the substrate.

[c43] 43. The method of claim 39 wherein:

the test socket has an opening in the support surface about which the apertures are arranged; and

placing the microfeature device in the test socket comprises placing the microfeature device in the test socket with some of the interconnect elements received partially within corresponding apertures and other interconnect elements at the opening.

[c44] 44. The method of claim 39 wherein:

the apertures in the support surface are arranged in rows and columns corresponding to an array of interconnect elements on the microfeature device; and

placing the microfeature device in the test socket comprises placing the microfeature device in the test socket with the array of interconnect elements received partially within corresponding apertures.

[c45] 45. The method of claim 39 wherein placing the microfeature device in the test socket comprises placing the microfeature device in the test socket with several of the interconnect elements having a greater cross-sectional dimension than a cross-sectional dimension of the corresponding apertures.

[c46] 46. The method of claim 39 wherein providing the test socket comprises:

providing a test socket body having a recess and a shelf in the recess; and

placing a support member having the support surface and the apertures in the recess so that the support member is carried by the shelf.

[c47] 47. A method of testing a microfeature device having a substrate and a plurality of conductive balls on the substrate, the method comprising:

positioning at least some of the conductive balls of the microfeature device partially within corresponding apertures in a support surface of a test socket so that the substrate is spaced apart from the support surface; and

contacting the conductive balls with corresponding test contacts to test the microfeature device while the microfeature device is received within the test socket.

[c48] 48. The method of claim 47 wherein positioning at least some of the conductive balls comprises aligning the conductive balls on the microfeature device with corresponding test contacts.

[c49] 49. The method of claim 47 wherein positioning at least some of the conductive balls comprises providing a gap between the substrate and the support surface so that debris on the support surface does not contact the substrate.

[c50] 50. The method of claim 47 wherein:

the support surface further includes an opening;

the apertures are arranged around the opening; and

positioning at least some of the conductive balls comprises positioning some of the conductive balls partially within corresponding apertures and other conductive balls at the opening.

[c51] 51. The method of claim 47 wherein:

the apertures in the support surface are arranged in rows and columns corresponding to an array of conductive balls on the microfeature device; and

positioning at least some of the conductive balls comprises positioning the array of conductive balls partially within the corresponding apertures.

[c52] 52. A method of manufacturing a test socket for receiving a microfeature device having a substrate and a plurality of interconnect elements projecting from the substrate, the method comprising:

providing a test socket body including a recess and a shelf in the recess; and

placing a support member in the recess so that the support member is carried by the shelf, the support member having a plurality of apertures positioned to receive corresponding interconnect elements of the microfeature device, the individual apertures being sized to receive a portion of the corresponding interconnect elements so that the substrate is spaced apart from the support member when the microfeature device is received in the recess.

[c53] 53. The method of claim 52, further comprising constructing the support member by forming the plurality of apertures in rows and columns corresponding to an array of interconnect elements on the microfeature device.

[c54] 54. The method of claim 52, further comprising constructing the support member by forming an opening in the support member and the apertures around a perimeter of the opening.

[c55] 55. The method of claim 52, further comprising constructing the support member by forming the apertures such that the individual apertures have a cross-sectional dimension less than a cross-sectional dimension of the corresponding interconnect elements.

[c56] 56. The method of claim 52, further comprising constructing the support member by forming the apertures such that the individual apertures have a first portion with a first diameter and a second portion with a second diameter greater than the first diameter.

[c57] 57. The method of claim 52, further comprising constructing the support member by forming the apertures such that the individual apertures have a beveled portion.

[c58] 58. A method of manufacturing a test socket for receiving a microfeature device having a substrate and a plurality of conductive balls on the substrate, the method comprising forming a test socket including a support surface and a plurality of apertures in the support surface corresponding to at least some of the conductive balls of the microfeature device, the individual apertures being sized to receive a portion of the corresponding conductive ball so that the substrate is spaced apart from the support surface when the microfeature device is received in the test socket.

[c59] 59. The method of claim 58 wherein forming the test socket comprises:

forming a ball support member having the support surface and the apertures in the support surface; and

placing the ball support member in a recess of the test socket.

[c60] 60. The method of claim 58 wherein forming the test socket comprises forming the apertures in the support surface in rows and columns corresponding to an array of conductive balls on the microfeature device.

[c61] 61. The method of claim 58 wherein forming the test socket comprises forming an opening in the support surface and the apertures around a perimeter of the opening.

[c62] 62. The method of claim 58 wherein forming the test socket comprises forming the apertures in the support surface such that the individual apertures have a diameter less than a diameter of the corresponding conductive ball.

[c63] 63. The method of claim 58 wherein forming the test socket comprises forming the apertures in the support surface such that the individual apertures have a first portion with a first diameter and a second portion with a second diameter greater than the first diameter.